Lessons in Apples

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If stones may contain sermons, certainly apples may be expected to harbor at least a few lessons. Actually, they are regularly used in scores of thousands of classrooms in biology, botany, and general science and are admirable objects for class study for a variety of lessons.

Their use is desirable, not only because of their abundance and cheapness, and the intrinsic interest of their structure and functioning, but even more because of the pedagogic importance of leading beginners in science to realize that the most familiar objects may present intellectually stimulating mysteries. The all-too-frequent bromide, "How can you bear to pull a flower to pieces? I just love to enjoy them for their beauty," represents a common adult attitude of mind which constitutes a difficult bar to the advancement of science. It is one of the science teacher's privileges to interfere with the habituation of children into that fatuous attitude, and to show by the use of flower and fruit material in the classroom that the study of the internal structures reveals intellectual beauties and harmonies of the highest type without detracting one whit from the emotional stimulation aroused by external beauties of form and color.

Out of a variety of lessons in which apples may be usefully employed in elementary instruction, three, which are thought to have special application in high school teaching, are considered in the pages which follow. The purpose of this paper is not to present necessarily any new facts about apples, but rather to assemble a series of observations relating to the use of apples as teaching material. It is worthy of emphasis, however, that there are many undiscovered details regarding the commonest biological material and that this constitutes one of the chief challenges to interest of this subject, both for the teacher and, as a point of view for classes.

What is an Apple?

To define the apple in terms of the usual definition of a fruit, we find that the full, triply phrased statement is required: An apple is (1) "a ripened ovulary (2) with its contents, the seeds, and (3) with any closely adhering floral parts." Actually, thus,

the apple consists chiefly of the thickened and fleshy, edible stem (receptacle, or 'adhering floral part'), in the center of which is buried the ovulary, constituted of an outer, fleshy layer, and the inner fibrous surface, immediately enclosing the five locules, each with a few seeds (typically not more than two).

Usually it is rather easy to distinguish between the tissues of the receptacle and those of the ovulary wall, although their con-

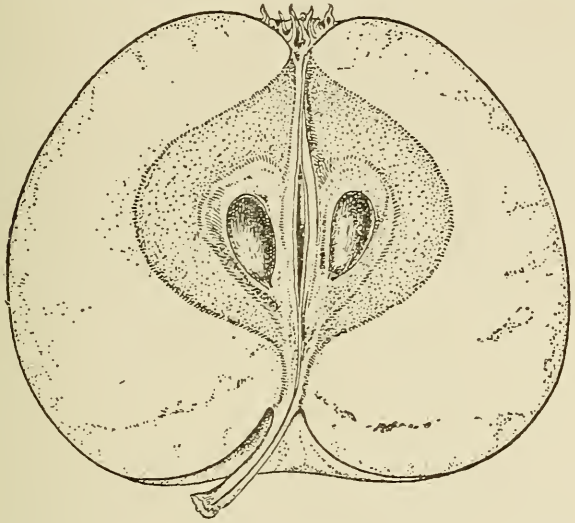

Figure 1. What's wrong with this picture? The figure represents a too conventionalized diagram of a lengthwise section of an apple, taken from an elementary botany text. Comparison with figures 5 & 6 of Plate 4 will show the inaccuracy of representing opposite locules. The densely dotted area represents ovulary wall.

sistency and flavor are similar. Some varieties show the distinction more plainly than others; e. g., the Jonathan, in which the ovulary wall begins to turn brown as soon as exposed to the air, and assumes a different shade of color from the mass of receptacle tissue. In length-wise sections, the line of demarcation is most plainly shown when the cut has been made along one of ten principal fibro-vascular bundles. In cross sections there is a distinct line which connects the ten bundles, usually showing a definite though irregular course, which varies in different varieties of apple.

Textbooks galore contain illustrations of the internal structure of apples. Unfortunately, such illustrations are too frequently conventionalized to an extent that they present definite and unnecessary inaccuracies. These are to be found, not only in general science and elementary biology texts, but also in first year botanies bearing distinguished authorship.

The first illustration is taken from the latter source. Perhaps the artist thought it necessary to meet the common desire for balanced structure, and thus showed opposite locules where such can not occur, unless abnormally. It would seem, however, that there is no more reason for misrepresenting the internal arrangements of apple carpels than there is for showing all twigs with opposite leaves or scars. Such conventionalization, if intentional, is contrary to the fundamental aim of teaching accuracy of observation and representation, and, in any event, the mistake hardly seems to offer any real advantage.

A similar conflict between strict accuracy and the desire for a balanced drawing presents itself also in diagrams of flower structure. Here, however, there is no single structural type concerned. The diagrams are not usually identified with any specific flower, and the picturing of opposite petals, with subtending sepals and associated stamens, a combination scarcely obtainable in nature, is justified as a generalized diagram.

An actual cross section of an apple shows clearly why the representation of opposite locules in a lengthwise section is inaccurate. The five locules stand out in a clear-cut star pattern, which varies according to the stage of ripening, and among different varieties. (Plate 3, figs. 8–12)

Can you cut a lengthwise section so as to get an exact bisection of the pentagonal figure? This constituted an annoying problem for me until I found that the five sepal lobes furnish a definite clue, and that by cutting between two lobes and through the opposite one, an accurate bisection of the locular figure may usually be obtained. (Plate 3, figs. 5 and 6)

What variety is best for class study? The problem of bisecting the star was further simplified when some study was made of the common varieties of apples usually available in the markets. Some types are definitely better than others. The difference is not so much between named varieties themselves, as between the long or western and the short or eastern shapes

which seem to characterize the apples of these different regions. The same variety shows marked variation in shape according to its locale.

In the elongated 'sheep nose' shape, there is generally a clear, external indication of the pentagonal nature of the fruit. The "Delicious" variety shows five prominent knobs at its distal end; so, also the western Spitzenberg, though less prominently. Both these apples are more or less five sided and angled in cross section, as is the "Winter Banana," which in addition, often shows narrow, roughened ridges along the angles. (Plate 3).

In these types of apple, it is relatively easy to locate the knife cut so that it will bisect the internal pentagon. In the broader, oblate form, there is usually no external indication except the rather indistinct five sepals to guide the location of the cut. The longer apples are further much better for the study of the vestiges of the stamens, sepals , and style. The little cavity under the sepals is deeper, broader, and the three parts stand out distinctly. It is even possible to count the twenty stamens.

Apple Varieties and Breeding

Some twenty years ago I recall reading that there were then over one thousand named varieties of apples. Since then, the numbers have undoubtedly been considerably augmented. Relatively few, however, find their way into city markets but there are enough different types which can be easily obtained during the school year to make apples especially available for studies in variation and classification.

Posit the problems: How many kinds can you name? What are the distinguishing characteristics? What are the best varieties? The collected material which a single class may bring in will furnish the basis for a good laboratory exercise in which a list of such differential features as the following may be discovered: color, and color patterns; size and shape; surface, whether with bloom, like the McIntosh Red, greasy like the Pippin, or not so distinctive; toughness of skin; texture of flesh, whether firm or mealy, juicy or dry; flavor, whether sweet, sour, intermediate, or with a special flavor like the Winter Banana.

The market varieties available will vary according to the season of the year. The collection to be found during the fall

months will include several which will be missing by mid-winter and spring. As each apple variety passes toward the end of its marketable period, its flesh becomes progressively mealy, owing to the gradual digestion of the middle lamellae. The best keeping types are those in which this change is delayed the longest. The old Russet variety probably holds the record in this respect, as it can be kept in ordinary farm cellar conditions well into the July following its harvesting. The early ripening summer and fall apples, some of which have extremely delicious flavors, are poor in keeping qualities.

During the past fall, in a casual study of the varieties offered in a few city stores, and with contributions from two or three friends, the following sixteen different sorts were collected; Winesap, Jonathan, Delicious, Greening, Pippin, Lady, Snow, McIntosh Red, Winter Banana, (eastern and western), Spitzenberg (eastern and western), Russet, Baldwin, York Imperial, and Rome Beauty. The average store keeper cannot be relied on for identification. Two of them insisted that the Pippins were Greenings, although admitting that real Greenings were different. As a matter of fact, all the above list displayed rather well marked differences. In a larger field of varieties, their differentiation would not be so easy, but for the purposes of classwork, the number obtained would probably be even smaller and the difficulties fewer.

From the standpoint of plant breeding, the recognition of the distinctive varieties and their differential characteristics would offer an excellent basis for considering the problems of selection as for flavor and texture, keeping and marketing etc. The fact that apple breeding has been chiefly a matter of discovery of branch mutations or chance seedlings, and their propagation by grafting, and that most of our current varieties are old,—the McIntosh Red is a 1796 seedling,—would serve to re-emphasize the relative newness of modern scientific as opposed to the older empirical breeding methods. The distinctive forms in the same variety, as represented by western and eastern fruit of the same name, constitute an excellent example of variation due to environment.

Adaptations of the Apple

It is always interesting to propose for the first time to a class of youngsters the problem: Why are ripe apples bright-colored,